# EXPLORATIONS
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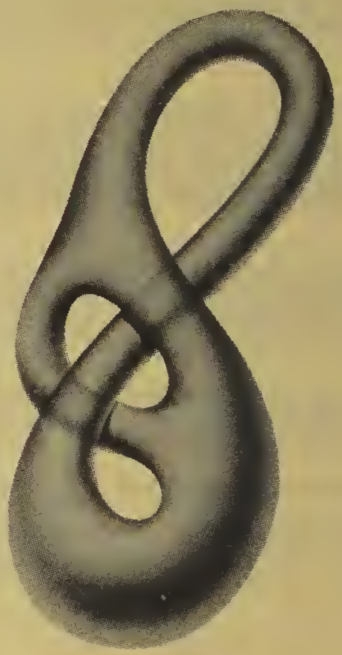
*Editor*: MARSHALL MCLUHAN

Mathematics and the Language of Literary Criticism R. J. SCHOECK



# MATHEMATICS AND THE LANGUAGE OF LITERARY CRITICISM

My aim is modest: I want only to be suggestive, perhaps outrageous and challenging, but at least suggestive, even at the risk of becoming exhortatory. I shall probably be raising as many questions as answers; but I assume a near-eclipse of mathematical light among my fellow-humanists, and among scientific colleagues something less than the total enlightenment of humanism: that we should discuss even the possibility of relations between mathematics and one of the humanistic disciplines seems to me to be very much worthwhile. As a starting-point, then, I would offer to fellow humanists this text from Hugh of St. Victor's twelfth-century *Didascalicon*: "mathematics never operates without the imagination."

## Metaphors

Let me begin with the business of metaphors. The metaphors that we use to describe literary relationships, or change and continuity in literary history, are well worth periodic examination. The metaphor of the "house of literature"—with many rooms, among other features—no longer seems very satisfactory; but many will repeatedly speak of "charting" or "mapping" without full realization of the limitations of such a metaphor, or of the consequences in flattening, in making the features on such a literary map quite fixed. (Some time ago, in the *University of Toronto Quarterly* of January 1963, in speaking of the writing of intellectual history, I myself was guilty of this, and played with the further metaphor of drilling, and sampling, in order to compare two techniques of writing the history of Italian literary criticism.)

Obviously, we all feel the need for metaphors to enlarge or enrich the literal statement, to extend the reach of concept, as does Sir Philip Sidney in his *Defence of Poetry*, wanting to reinforce the contrast of vice and virtue: "Now, as in Geometry the oblique must bee knowne as well as the right, and in Arithmeticke the odd as well as the even, so in the actions of our life who seeth not the filthiness of evil wanted a great foil to perceive the beauty of virtue." We all turn to metaphors in our writing as in everyday speech, and even the supremely romantic imagination of William Wordsworth was capable of operating at times in geometrical metaphors, albeit pejoratively, as in describing one aspect of his school-time in *The Prelude*:

> But who shall parcel out
> His intellect, by geometric rules,
> Split, like a province, into round and square?
> (II, 208–10)

There is great virtue in making use of the metaphors of the period itself, and M. H. Abrams' justly praised description of Romantic literary criticism is a conspicuously successful analysis of that criticism and use of a metaphor drawn from the period under study: *The Mirror* of neo-classical criticism is juxtaposed with *The Lamp* of romantic criticism, although a more obviously organic metaphor might be the growing plant. In "The King's Two Bodies" Ernst Kantorowicz found a unifying metaphor which enabled him to structure a vast and complex body of political, theological and juristic knowledge and tradition.

Still, sufficient attention has not been paid to the business of characteristic metaphors and to the consequences of employing them. In all of the writing on Plato and Aristotle—and I am here reflecting only on the question of their thoughts on literature and literary functions—very little seems to have been said about the buried mathematical metaphors in Plato in contra-distinction to the biological metaphors in Aristotle, although the recent *Bibliographie zur Antiken Bildersprache* (Heidelberg, 1964), which carries from the classical tradition down through Augustine to Isidore, should prove a most valuable tool. In that most famous of Aristotelian critical metaphors, *catharsis*, ought we not to see the very physiological metaphor of *purging* in something of Aristotle's post-Platonic light? Nothing could be more deliberately non-mathematical than that famous metaphor, for as Bywater has noted, *catharsis* very generally denotes physical clearance or discharge, and in the *Politics* there is a similar process in reference to certain emotions. In the tragic experience, therefore, the excitement is both necessary and good: "it serves as a sort of medicine, producing a *catharsis* to lighten and relieve the soul of the accumulated emotion within it; and as the relief is wanted, there is always a harmless pleasure attending the process of relief."

During the Middle Ages there was a great deal of biologizing in many areas:

thus, the soul is *nutritive*, *appetitive*, and so on. And (carrying on from Aristotle's *Politics*), the state is like an animate nature, or even an animal. The widely-read and long-influential ideas of Marsiglio of Padua on church and state often particularize in medical analogies. In short, there was much "biologizing of natural law concepts" (thus Morrall), and a drift or organic tendencies generally in the political thought of the period (thus Ewart Lewis).

Recent historical and literary scholarship has studied the light metaphors in medieval aesthetics pretty extensively, but there has not usually been very much relating of these metaphors to other characteristic metaphors of the period, or to habits of conceptualizing in and utilizing of metaphors. The Renaissance was especially fond of metaphors of light, and employed them most often to describe its own sensed relationship to the past: hence, the metaphors we have inherited of the "dark" ages, and of that period of Petrarch and his followers as a "rebirth", with its own new brightness. Petrarch was also fond of the river metaphor to describe his newly-heightened sense of continuity and tradition, and it may well be that this metaphor rather adequately handles Petrarch's sense—but I want to return later to the challenge of representing continuity. One final example of Renaissance metaphors was one which they inherited from their medieval masters, the mirror or speculum. But the medieval use of the speculum was, more often than not, to enable a man to see himself *sub specie aeternitatis*. The Renaissance man used the mirror to see himself as well as to hold the mirror up to nature. (Lewis Mumford has in fact argued for the effect of an increasing use of the glass (mirror) in the ego during the Renaissance: see *Technics of Civilization* (1934), 128 ff.)

It is one thing consciously to employ a living metaphor and to play with the overtones, or outward-reachings, of its operation; but when the metaphor dies, something else is likely to happen. Too often our thinking is patterned by dead metaphors without our being aware: as one example, the word *encyclopedia*, which originally was a living metaphor, *a circle of learning*—that is, a complete education—but we shall return to the circle later. It is well, then, from time to time to reflect upon the limitations of metaphors that we habitually employ, and for too long, I would suggest, literary people have been employing biologically oriented metaphors—organic theories of poetry, considerations of the poem as a plant, and all that—without sufficient awareness.

Of course, the metaphor is a powerful tool. (What wit first quipped that a man's reach should exceed his grasp, else what's a metaphor?) And Aristotle strongly asserts that to be a master of metaphor is the greatest poetic gift. Metaphor, he writes in Ch. xx of the *Poetics*, is formed on the basis of analogy, and is proportional.

But a man may cut himself on his own knife, Boethius and Chaucer remind us. And all tools need sharpening.

### Mathematics as a source for metaphors

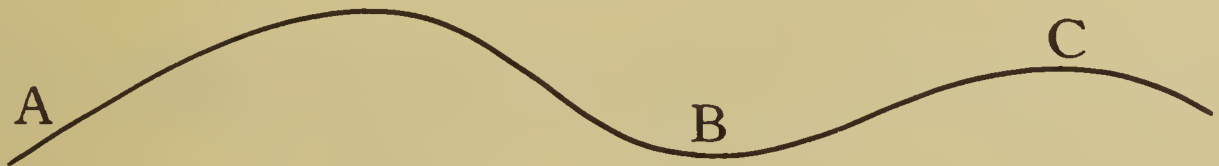
It was chiefly Cicero who was responsible for giving so strongly rhetorical a cast to Western culture; clearly, the Greek tradition had been heavily mathematical, and with the Greeks rhetoric and mathematics were never too widely separated—as the example of *hyperbole* and *hyperbola* would suggest (and likely the Greek rhetoricians would conceive of the rhetorical hyperbole as akin to the hyperbolic curve). The history of humanism, and consequently of the culture of Western Europe at least to World War I, can very nearly be written in terms of rhetoric.

All of this has changed, and in several ways. First, we seem to have passed through nearly half a century of rather violent anti-rhetoric, and now are witnessing renewed study in the sources and resources of the rhetorical tradition (notably in the work of McLuhan and Ong in contemporary English studies, earlier in the work of Croll, German philology and French stylistics). The study of rhetoric is more alive today than it has been for many decades. Rhetoric and literary criticism are both amenable to fresh possibilities.

And, perhaps more notably, we have generations of students coming into the universities who have had more mathematics than has been the case for humanities students for some time. It may be that they are capable of discovering affinities between literature and mathematics; it is certainly true that they seem to understand mathematical principles better than their immediate predecessors, who found that any possible relating had been left altogether to the curriculum and no attempt to achieve it was made for them in individual courses or lectures. And, at a time when the frontiers of literary criticism appear to have been stabilized, and some of the sages are looking for new tools and new techniques, mathematics is eminently worth consideration. Besides, the very inquiry may help to improve communications between the two cultures.

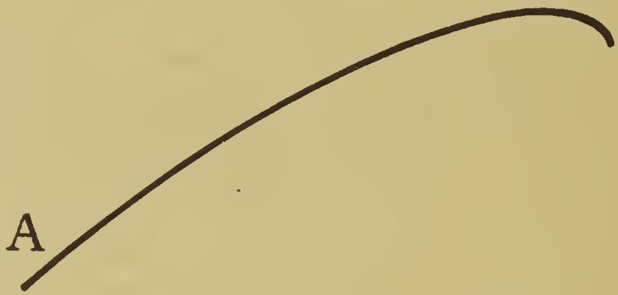
### "Streams" and continuities

Let us take the problem of describing consecutiveness of literary events. The old "organic" scheme, still very much with us, is that of the river:



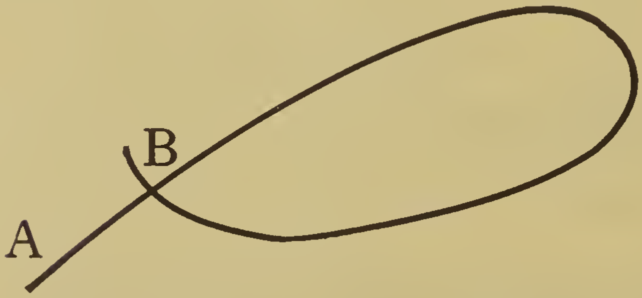
This is a rather primitive way of describing such relationships, and indeed it challenges the very notion of writing literary criticism. At point "A" on this river, we found Homer writing his *Odyssey*: and at Point "B" Tennyson and his Ulysses; and at point "C", Joyce. (Perhaps in some minds there would be awareness of a double metaphorizing of rivers and time, but the recent essay of J. J. C. Smart on "The River of Time" in *Essays in Conceptual Analysis*, 1956, reveals how curiously inescapable such a metaphor may seem at the very moment that it is leading us astray.) Clearly, according to such a diagram, points A and B and C are separated, and the representation seems to imply that no direct connection between A and C is possible *because* something else (B) has come in between. Under examination, this conventional representation is most unsatisfactory.

Let us turn to modern topology for what I suggest is a more sophisticated metaphor.

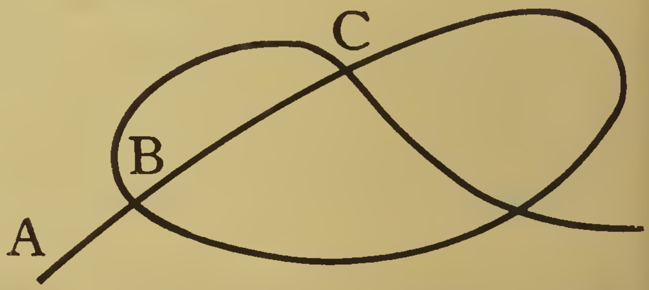


(FIG. 2)

If "A" is the starting-point—in our case, Homer and the Ulysses theme (to use W. B. Stanford's phrase, from his most illuminating study)—then there is a kind of continuity which follows from that point, for a time. Until something bends the "line" and re-establishes a new relationship at point B (fig. 3), and another at point C (fig. 4): this metaphor, I am suggesting, more nearly dramatizes what does take place in the operation of literary relations (or in the behaviour of literary themes, if you like) than does the straight-line, or single line, of the stream metaphor.



(FIG. 3)



(FIG. 4)

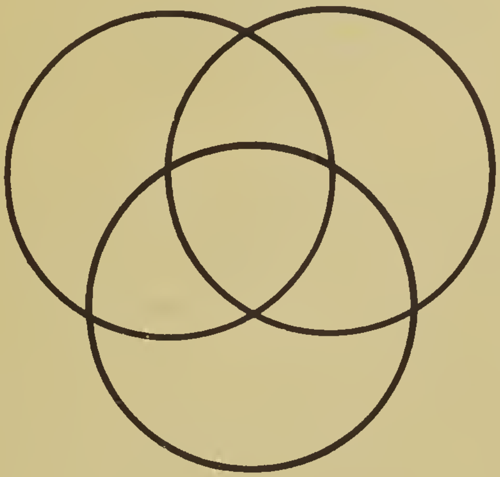
Clearly, it provides us with a more satisfactory diagramming of continuity and discontinuity. Further, is this not more nearly Eliot's concept in *Tradition and the Individual Talent*?

> . . . what happens when a new work of art is created is something that happens simultaneously to all the works of art which preceded it. The existing monuments form an ideal order among themselves, which is modified by the introduction of the new (the really new) work of art among them . . . . and so the relations, proportions, values of each work of art toward the whole are readjusted . . .

(Both for the literary critic and the literary historian, there is much food for reflection in Riemannian geometry, with its ability to describe variables in a flux, which is one way of beginning to account for a literary expression.)

## The Three Rings

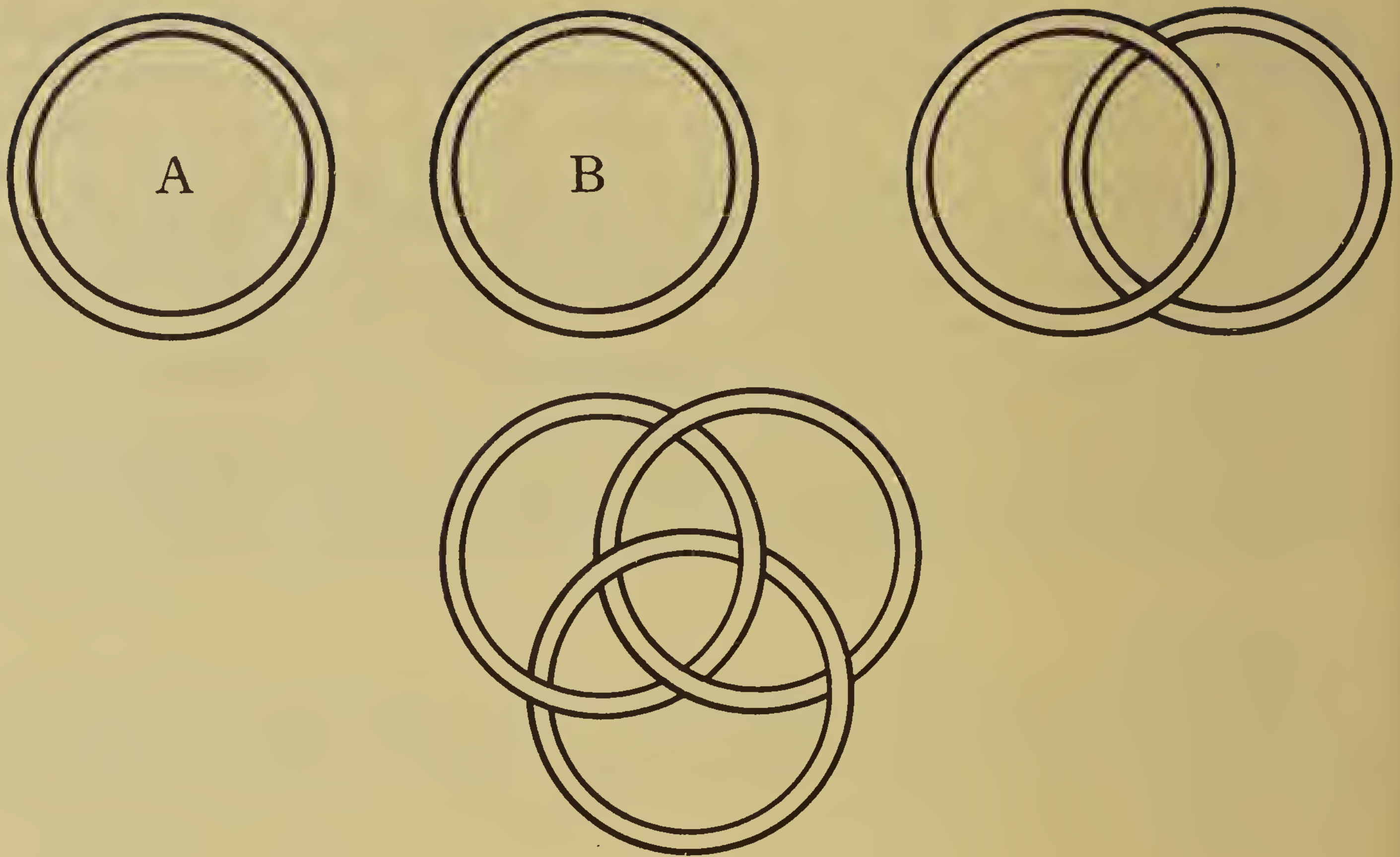
In teaching underclassmen for some years I have resorted to the three rings made famous by an American brand of beer to suggest the interrelatedness of author, work and audience.



(FIG. 5)

The figure conveniently suggests aspects of interrelatedness and emphasizes that there is a central area in which all three circles of influence or interest are involved.

Recently I have learned that this device earlier appeared in the coat of arms of the Borromeo, a famous Italian family of the Renaissance, and hence are sometimes known as the Borromean rings. A notable feature of this configuration of interlocked rings is that no two of the rings are linked:



(FIG. 6)
Circle A is laid on B
Then C on both

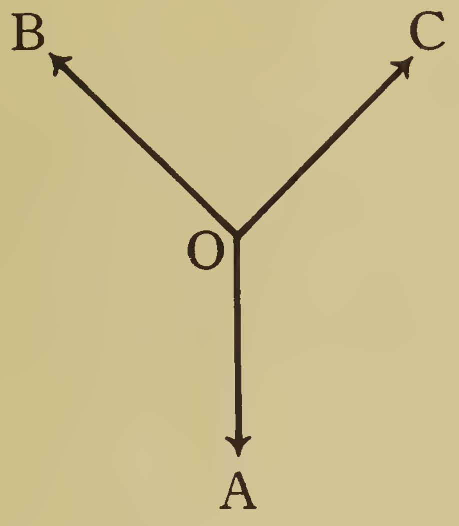
yet the group of three rings cannot be separated—it is as though any one of the rings serves the same function as the middle term of a syllogism. Thus it will be readily seen that if any single ring is broken and removed, the remaining two rings will not be connected.

To suggest an analogy between the three rings and the three central concerns of literary criticism—author, work, and audience—is to analogize, to operate by using the diagram as a metaphor. And the use of a diagram as metaphor is itself an intriguing problem, one which seems increasingly to concern critics of Northrop Frye's schemata and critical structures. Most recently, J. Max Patrick has commented on this in reviewing Frye's clockface diagram of *Paradise Lost*, in *The Return of Eden* (University of Toronto, 1965), for the *Seventeenth-Century Newsletter* (Spring, 1966, pp. 1–2), with the judgment that the diagram has been imposed too rigorously upon the poem; a real and present danger, of which all critics should be aware.

## Tension and polarity

For another example I would turn to another kind of problem, and to another area of mathematics. I have recently been concerned with a discussion of the nature of the Renaissance and the Reformation, and specifically with an attempt to account for relationships of different forces at a given historical moment. In Tudor England, the pulls of humanism, of reformation, of scholasticism, and other movements and factors, are divergent, but not I think necessarily completely in opposition: for many religious forces—concerns of Scriptural study, of liturgical practice, of mysticism—are not always, certainly not easily, to be identified with just one of the above pulls, and Thomas More in his famous Letter to Oxford University gives a fine rendering of the tensions he observed about 1518.

Vector analysis, I would suggest, might help to account for such divergent pulls—metaphorically, not absolutely.

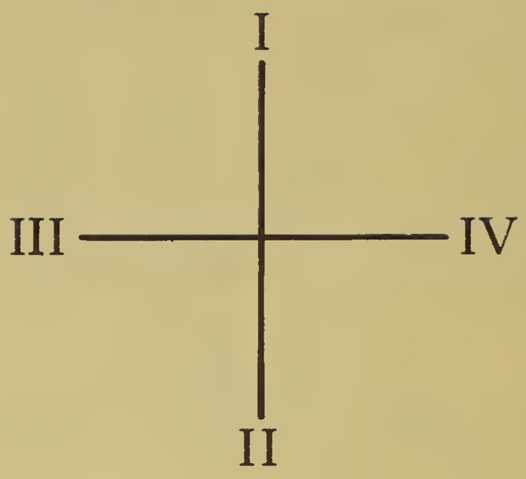


(FIG. 7)

In terms of More's letter, OA might represent the scholastic, anti-Greek force; OB, the humanistic, pro-Greek force; and OC, that of reformation.

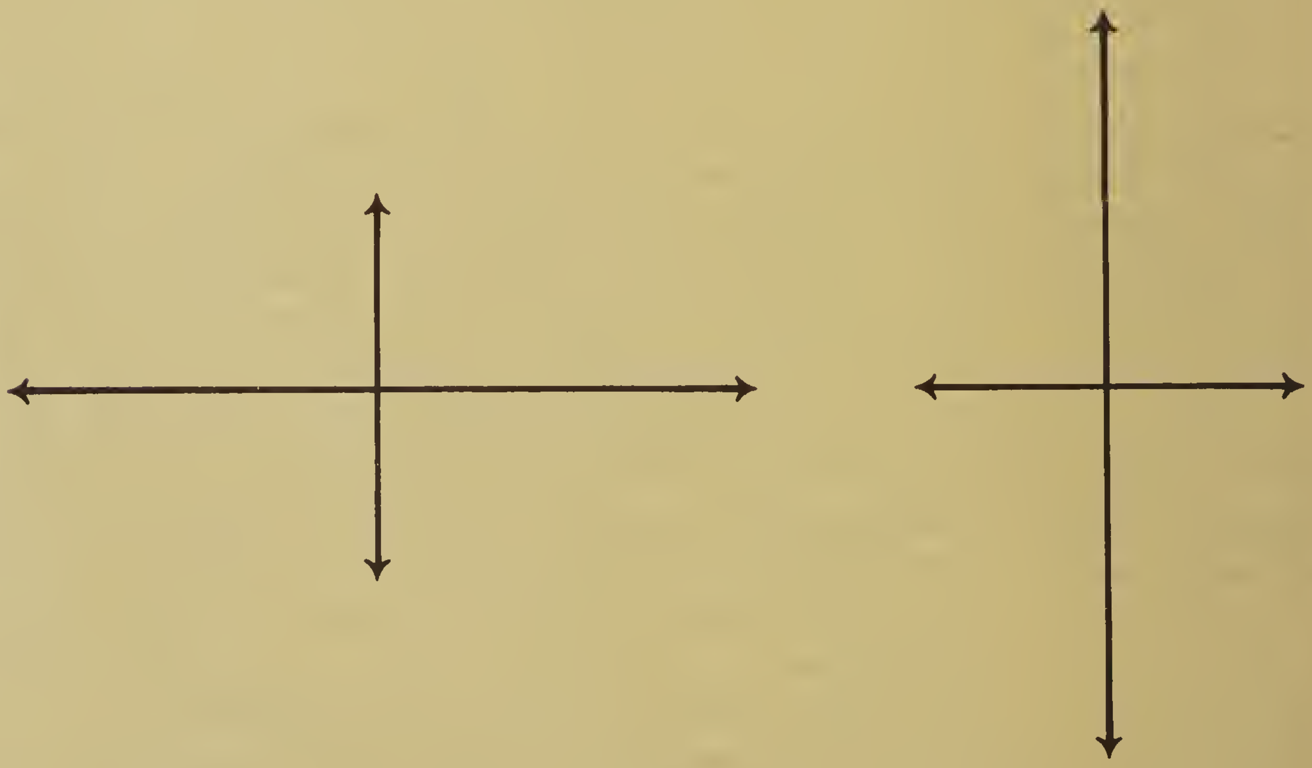
But I offer this simple diagram with awareness of the complexities of offering a diagram as itself a metaphor; and I am at least dimly aware of such studies in depth of polar tensions as that of Louis Norris (*Polarity*, 1956), which initiates discussion by pointing out that polarity is at the very core of Aristotelian physics (*Physics* 188a20), yet has enormous potential in contemporary philosophical discussion, provided that we are not attempting to establish a kind of calculus of polarity and do not involve a question of mathematical precision in such efforts. And I would urge that in place of an earlier opposition of two extremes on a linear spectrum, we have at play a principle of polar tension in which there are counter-balancings not so much of abstract oppositions but of co-principles working to produce an equilibrium.

A few years ago, in *New Scholasticism*, 1958, Wimsatt suggested a theory of poetic tension that diagrams something like this:



(FIG. 8)

where I and II suggest an axis of speaker (or generic) oriented and of audience (or effective) oriented criticism; and III and IV, an axis of didactic (whether moral or religious or Freudian) and of formal criticism. But I would comment that this diagramming is much too static for the system of poetic tensions that Wimsatt seems here to have in mind, and I would urge that a modified vector analysis would be more appropriate, with such alternate possibilities as:



(FIG. 9 and FIG. 10)

## Objections

At about this point—if my humanistic confrères have stayed with me so long—I can hear mutterings, or more outspoken objections about failing to differentiate between the *quality* of a literary work and the *quantity* of a mathematical exercise. (How very medieval that distinction is! and I use the term first, historically, to indicate that the distinction was one which the middle ages perfected in assuming its heritage of Aristotelian and Boethian physics and metaphysics, and, secondly, with deliberate irony, pejoratively, to indicate that it is one of those medieval inheritances which we now think of as having only an historical importance.) Of course, humanities will be concerned to understand what Wolfgang Köhler has called "the place of value in a world of fact"; but there is a world of fact in the humanistic universe, and that there may be values in that of the sciences, we should be willing to grant.

## Poetry and Numbers

In the domain of poetry, there is much to explore concerning numbers, beginning with Dante's account (in *De Vulgari Eloquentia*) of numbers in the structuring of a stanza or of *canzone*; but as Curtius makes clear,

> the wonderful harmony of Dante's numerical composition is the end and the acme of a long development. From the enneads of the *Vita nuova* Dante proceeded to the elaborate numerical structure of the *Commedia*; $1 + 33 + 33 + 33 = 100$ cantos conduct the reader through 3 realms, the last of which contains 10 heavens. Triads and decads intertwine into unity. Here number is no longer an outer framework, but a symbol of the cosmic *ordo*.

(Thus E. R. Curtius at page 509 of *European Literature and the Latin Middle Ages*, in which there is enough material on numerical composition to launch several theses.)

Towards the end of this development, there is Gerard Manley Hopkins' most interesting use of mathematical formulae in accounting for sonnet structure:

> Now it seems to me that this division is the real characteristic of the sonnet and what is not so marked off and moreover has not the octave again divided into quatrains is not to be called a sonnet at all. For in the cipher 14 is no mystery, and if one does not know or avail oneself of the opportunities which it affords it is a pedantic encumbrance and not an advantage. The equation of the best sonnet is
>
> $$(4\ \ 4) + (3\ \ 3) = 2.4\quad 2.3 = 2\,(4 + 3) = 2.7 = 14$$
>
> (Correspondence with R. W. Dixon, p. 71)

Have we readers of the 1950's and 1960's yet caught up with Pound's very traditional sense of poetry as inspired mathematics? This traditional sense, in part, stems from the tradition we find in England of Spenser's "wise wordes taught in numbers for to runne", of Congreve's "magic numbers", of Pope's "I lisp'd in numbers, for the numbers came", and still of Longfellow's plaintive "Tell me not, in mournful numbers"—but a tradition which has escaped its historian. It is a very old humanistic tradition, one which Plato would have understood immediately, and Augustine, whose *De Musica* richly marries music, mathematics and poetry. The idea of inspiration leads us to the arithmetical rationalization of the Father with other members of the Trinity (as in Thierry of Chartres), and related though separable discussions of the soul and mathematics—perhaps best summarized by Macrobius' in *Somnium Scipionis*, ". . . the soul is a number moving itself"—which have been dealt with by Jerome Taylor in his edition of Hugh of St. Victor's *Didascalicon*.

Scott Buchanan's brilliantly suggestive, though somewhat sketchy, essay on *Poetry and Mathematics* was long out of print but it has now re-appeared in paperback; and we all have much to learn from his discussion of correspondences between words in poetry and numbers and figures in mathematics—between counting in arithmetic and recounting in literary narrative, between figure transformations in geometry and character development in the novel.

Have I failed to make clear that I have been employing diagrams as metaphors? I would not want them to be taken any farther. And here I might well indicate other self-imposed limitations. I have not ventured into the domain of mathematics and computer-language, and have done nothing with statistics: both computer-language and statistics have been related to literary criticism recently, and we shall no doubt be hearing much more of efforts of this kind: see "The Computer and the Humanist" and "This Wonderful Machine": "Some Thoughts on Computers and the Humanities" in *ACLS Newsletter*, xvii (Spring, 1966). Nor have I tried to say anything about logic as another bridge between humanistic discourse and that of the mathematician: both in symbolic logic and in the grammar of mathematical symbols there is much which we can contribute to and much from which we can learn about the theories and operations of signs and symbols. And I have steered clear of what was recently called the dangerous business of introducing mathematical certainty into textual criticism: "the light of *Principia Mathematica*, as reflected by The Calculus of Variants, can be a *ignis fatuus*" (thus TLS, 24 March 1966)—but something of this is covered in our forthcoming Toronto volume on *Editing Sixteenth-Century Texts.*

## Mathematics and the fine arts

In discussing mathematics and poetry, I have said little about mathematics and the other arts, although proportion obviously leads us to painting and numbers to music. While the connections between mathematics and music were well-known to the Greeks and continued to be viable for Boethius, Augustine, and the Middle Ages, the connections between mathematics and painting are less well-known, or at least less obvious. In the fifteenth century, Morris Kline has summarized: "The artists finally realized that the problem of perspective must be studied scientifically and that geometry was the key to the problem" (*Mathematics in Western Culture*, Oxford Galaxy, 1964, p. 132). The man who turned the key was Piero della Francesca, one of the best mathematicians of the century and the great master of perspective, whose *De Prospettiva Pingendi* closely related painting and perspective; indeed, later he tried to show that "the visible world could be reduced to mathematical order by the principles of perspective and solid geometry". While the most famous of artists to contribute to the science of perspective was Leonardo da Vinci, the most influential was Albrecht Dürer, whose widely influential treatise, *Underweysung der Messung mit dem Zyrkel und Rychtscheyd* (1528) argued that the perspective basis of a picture had to be constructed according to mathematical principles. Later names of prominence are Masaccio, Uccello, and Francesca.

In a forthcoming book, Professor Marshall McLuhan will discuss the entry of perspective into Renaissance poetry, and the pioneering character of Shakespeare's *King Lear* and the great achievement of Milton in this consideration will be a part of his argument. Concepts of light and shadow (for characters as for landscape), as well as distancing and background, are all involved in perspective.

In architecture, as a final note, Otto von Simson has argued for the vital role of the Pythagorean golden mean in the design of the Gothic Cathedral, but of course the Pythagorean theory of the "harmony of the spheres" reaches out to colour much medieval and renaissance poetry as well.

### Meta-metamorphoric possibilities

In addition to the matter of metaphor, may I intimate other possibilities that an increasing exploration of mathematics and the language of literary criticism promises:

(1) Mathematics is likely to lead to a greater concern with classification, to the particular form of a given work—to taxonomy, which will likely be related both to the Chicago structural analysis and to the Spitzer concern for "the exact understanding of the individual linguistic form" (as Auerbach has phrased it).

(2) We have much to learn from deeper and more careful explorations of logic:

> *a.* the logic of proof: in arguments and discussions, we have need to make more precise distinctions between suggestions and demonstrations and proof—I suggest that most graduate students need to be schooled on the hierarchy of notions and concepts, of supposition, of hypotheses and theories, and of laws.
>
> *b.* the logic of movement: and here the play of vector analysis has been strongly urged above.
>
> *c.* the logic of relationships: topology may well be one of our most important tools to develop a sharpening sense of influence, for source-studies and for genre studies.

We should then be more nearly ready for an Ong metaphor of the asymptote (cf. Wimsatt, *Short History of Literary Criticism*, p. 551), or, a little farther afield, a Blackmurian adduction of the 2d law of Thermodynamics in discussing the dynamics of the novel.

Edna St. Vincent Millay's sonnet *Euclid Alone Has Looked on Beauty Bare* is well-known for its description of Euclid himself, but the poem is largely descriptive and looks at mathematics from the outside. I would suggest that William Empson's employments of mathematical concepts are, like his handling of legal concepts, most imaginative, and a detailed comparison of his poems employing mathematical concepts with the Millay sonnet would demonstrate the difference between two levels of imagination. I have in mind such lines as these from Empston's "Dissatisfaction with Metaphysics":

> How smooth his epicycles round him run . . .
> New safe straight lines are finite though unbounded,
> Old epicycles numberless in vain. . . .

and from "Letter I":

> Too non-Euclidean predicament. . . .

or the explanatory note for "Letter V", which indicates the rich play of concepts of locus, points, and tangents in Empson's poems, and speaks indeed of the effect of being in non-Euclidean space. If Euclid's is a tactile world (as Kline, for one, has suggested), we can understand why the Gutenberg man should have clung to his Euclidean geometry so long; but in the post-Newtonian world of Riemannian and Lobachevskian geometry and logic, the tactile has been displaced: this newer world, long familiar to mathematicians and philosophers, is one which the literary critic and poetry must learn to live in—or, as Empson puts it, "*Your curve* (in 'Letter V') is the curve of the mirror which makes it reflect a wide area, like a camera obscura, but gives the reflection an odd geometry as in non-Euclidean space, so that you can't imagine yourself inside it". But we must try.

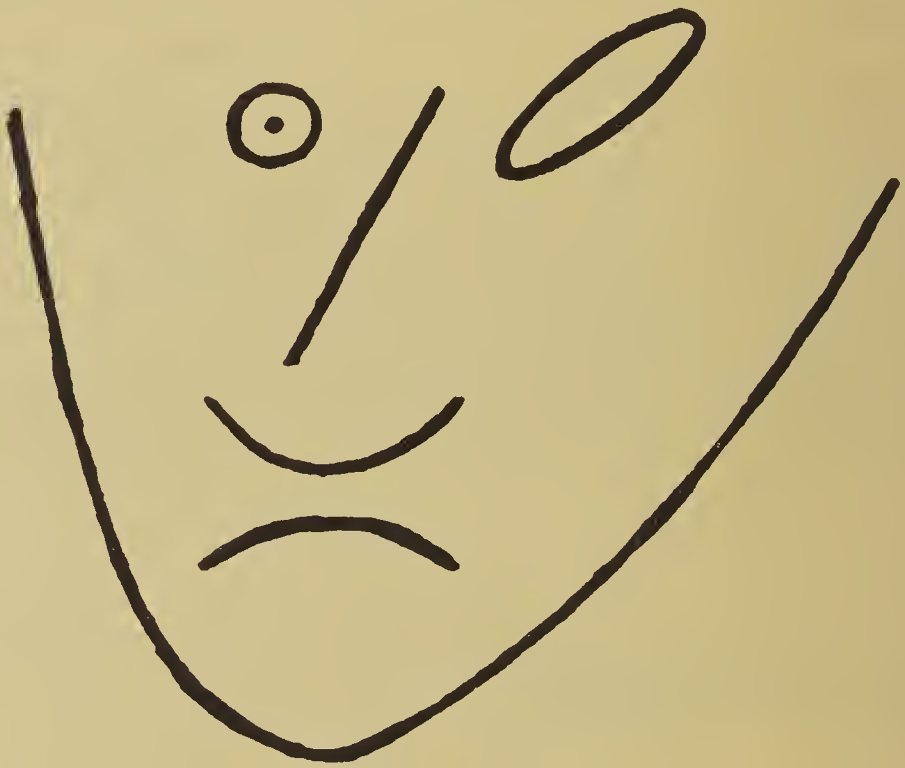
## Conclusion

I am not worried whether I may have betrayed some primitive, or erroneous, notions of mathematics: I have not yet checked out anything of what I have said with any of my mathematical friends. There may well be the generation of a certain degree of good-natured sympathy on their part towards a humanist for at least trying to speak their language—like that of a Parisian waiter towards an Anglo-Saxon Canadian student, or even that of a New York policeman stopping a Cornell professor driving the wrong way on a one-way street and dismissing him good-humouredly with a, "Well, go your way and do the best you can." Even though that is not alien to my main purpose, I have been aiming at something else.

My concern has been, first, to challenge you to think about the metaphors used in traditional literary criticism and to consider the extent to which these metaphors have conditioned our thinking; secondly, to urge an awareness of mathematics as a possible source for fresh, and more fruitful metaphors. If these things have been done with any degree of success, then perhaps we may explore more fully the deeper problems of the language of literary criticism and, at the same time, strengthen a bridge between mathematics and the scientific world, and criticism and the humanistic world.

R. J. SCHOECK, *St. Michael's College*

## CONIC SECTIONS . . . IN GEOMETRY AND LITERATURE



Although it has been said that the cultures of the humanist and of the technologist are far apart, we may note that at least the geometrician and the literary writer speak the same language. The names of the geometric figures (*conic* sections) arising from the intersection of a *plane* with a double cone aptly describe the various styles of writing. There are, for example, the *plain* talk of Sinclair Lewis, the simple *line* of Alexander Pope, and Bertrand Russell's arguments which head straight to the *point*. The "Divine Comedy" is a *parabolic* narrative on many *planes*. James Joyce makes frequent use of *ellipsis*, Candide's thoughts at times wander in *a circle*, and Shakespeare draws upon the *hyperbole*.

—*P. W. Cooper*

Jerome Ashmore, "Technology and the Humanities", in *Main Currents in Modern Thought*, 22: 3, Jan.-Feb., 1966, p. 68.